



MDA Challenges for Operational Research and Analysis

Dr. Ross Graham

Director General
Centre for Operational Research and Analysis



Defence Research and
Development Canada

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pour la défense Canada

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Outline

- Introduction
- Current DRDC MDA Technology Demonstration Projects
- Current DRDC Applied Research Projects
- OR&A MDA Challenges

Canada's national maritime domain is the largest and most diverse in the world and the Navy is the functional authority for Maritime Domain Awareness for the Gov't of Canada.

Regional Joint Operations Centres are key enablers

RJOC(W)

RJOC(E)


“By FY12/13, I envisage that significant scientific progress will have been made, in amongst other areas, in developing the information architectures required for maritime domain awareness in our three-ocean maritime estate.”

Vice-Admiral D.W. Robertson, CMS, from 12 Mar 08 Maritime Commander's Intent for 2009 to 2012



Current DRDC MDA Technology Demonstration Projects

- Northern Watch
- Exploitation of Space-Based AIS
- Persistent Active Surveillance of the EEZ (PASE)



Northern Watch Technology Demonstration Project Objective

To identify and describe combinations of systems for cost-effective surveillance of the unique environment of the Canadian Arctic.

At Sea, undersea,
on land and
in the air

Required for an effective understanding of activities and events in the North that could affect Canada's security, safety, economy, and environment.



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Resolute Bay, 10pm, 9 July 2007

Canada



Northern Watch TD – Scope

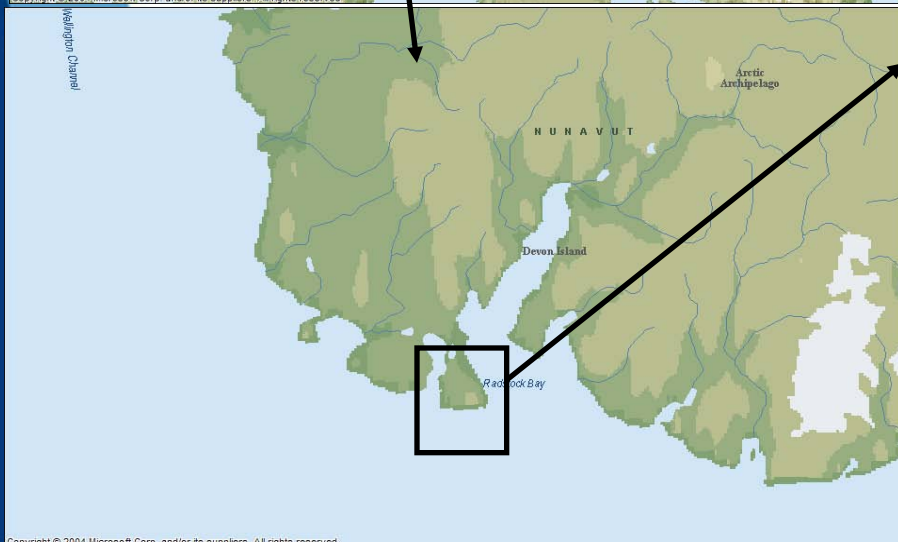
Choke-point Surveillance

- Demonstrate Persistent detection, tracking and identification
- Dedicated in-situ sensors (majority COTS/GOTS)
- Trade offs between communications, data processing and sensor integration
- Simulate other Assets
- Wide Area Approach Surveillance
 - Detection and tracking
 - Existing remote sensing assets
 - Simulate other Assets



Northern Trials Site

Checkpoint Site at Gascoyne Inlet



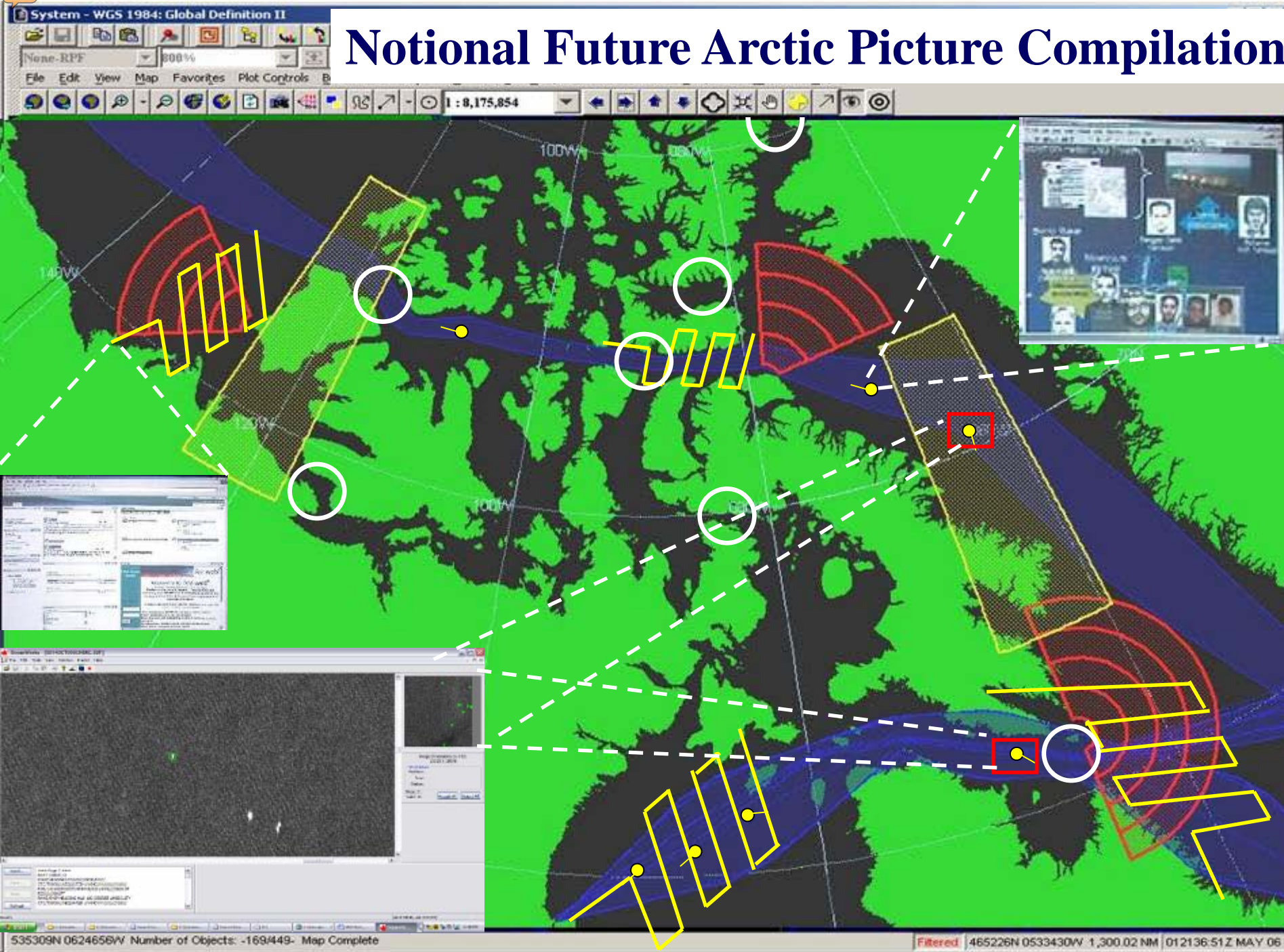


Sensors

- Search Radars
 - Terrestrial based low cost COTS
 - Space based Synthetic Aperture Radar
- Underwater (for surface and subsurface)
 - Acoustic
 - Electric field
 - Magnetic field
- Electro-Optic Infra-Red
 - Terrestrial based - active
 - Space based - passive
- Passive Radar Signal Detection and Direction Finding Receivers
- Automatic Identification Systems (Terrestrial and Space based)

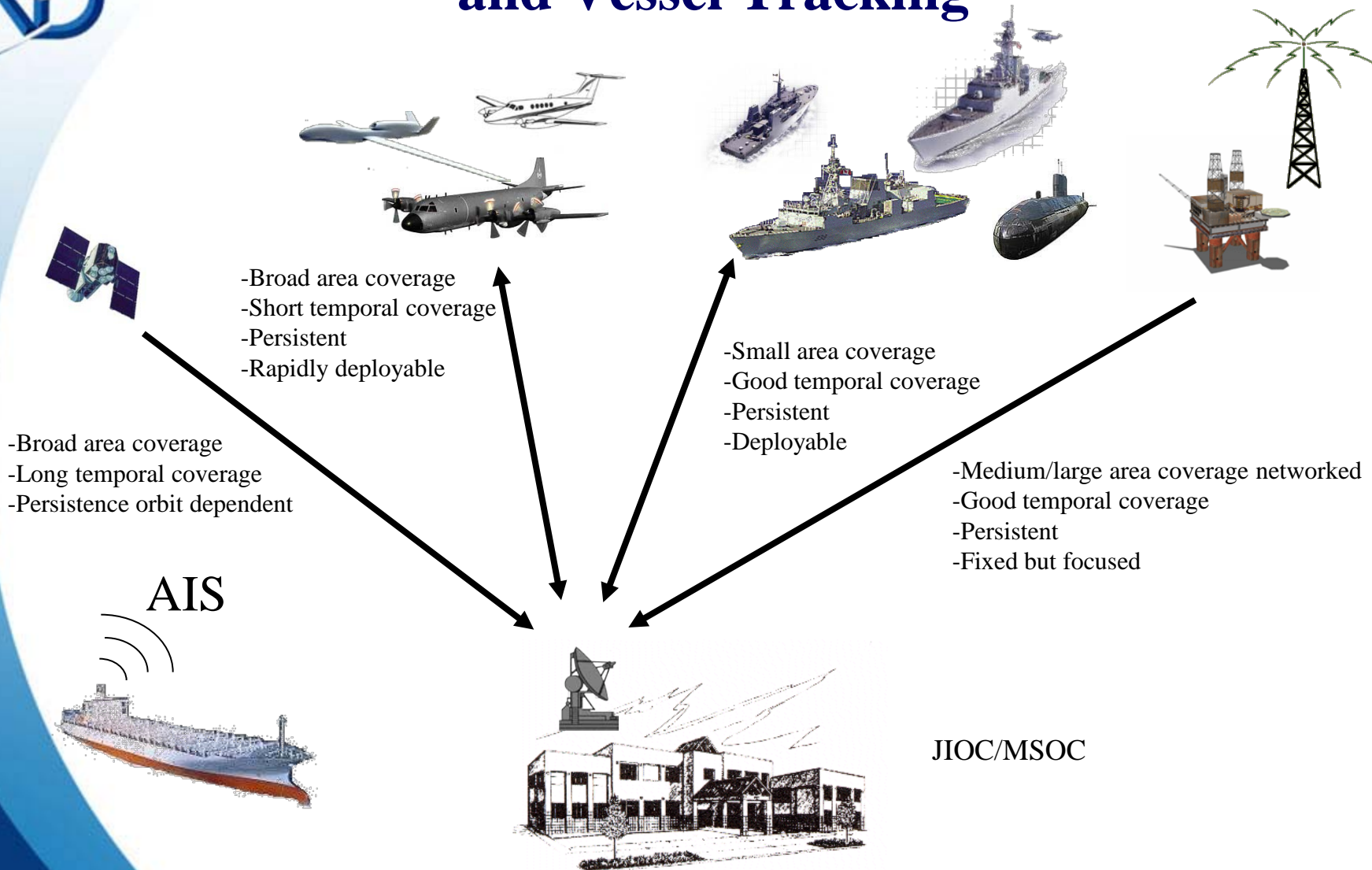
Note: Only select sensors will be included in the field trials. The others will be included in the studies.

Notional Future Arctic Picture Compilation





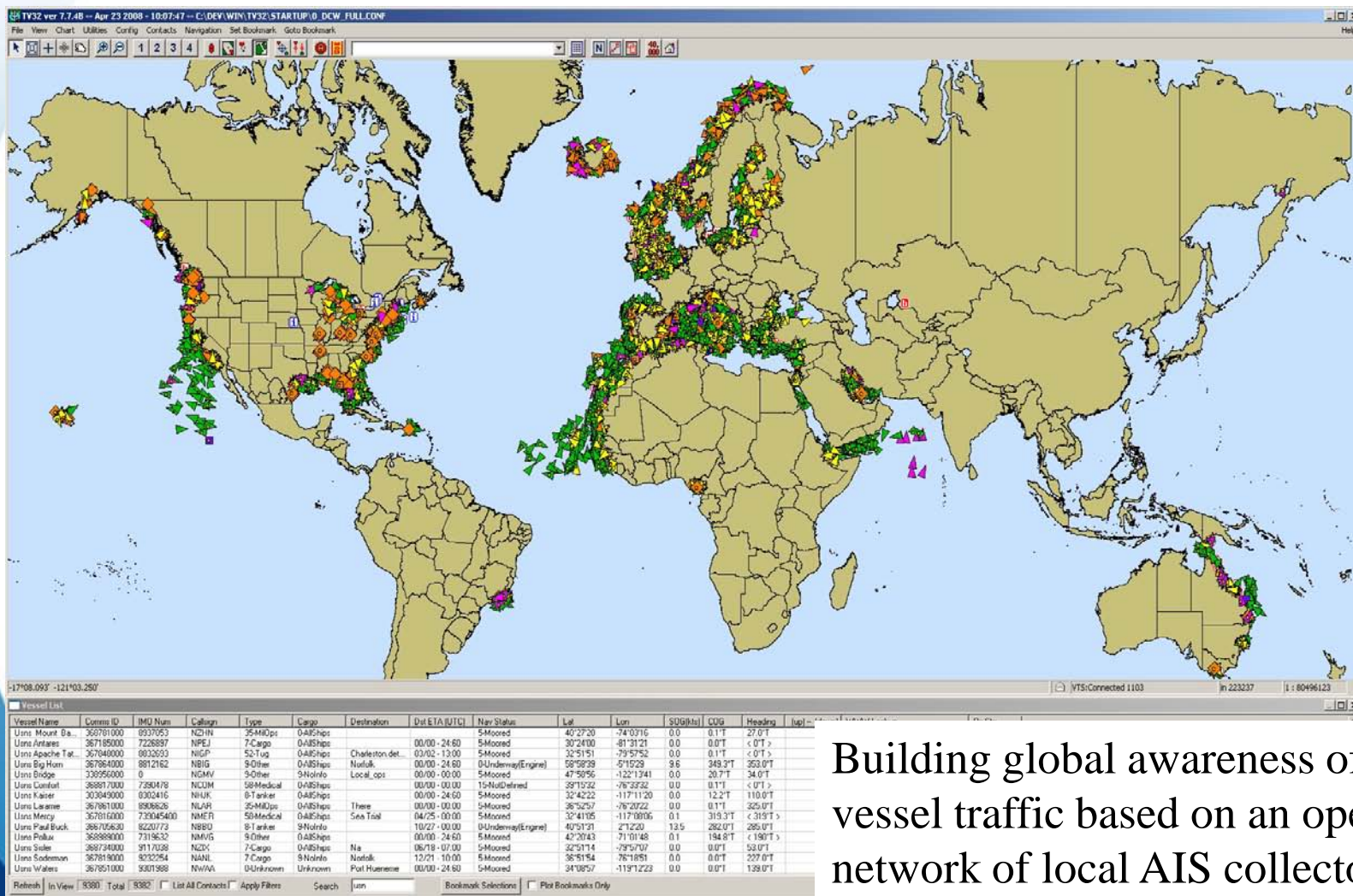
Automated Information System (AIS) and Vessel Tracking





Sharing AIS Information “Openly”

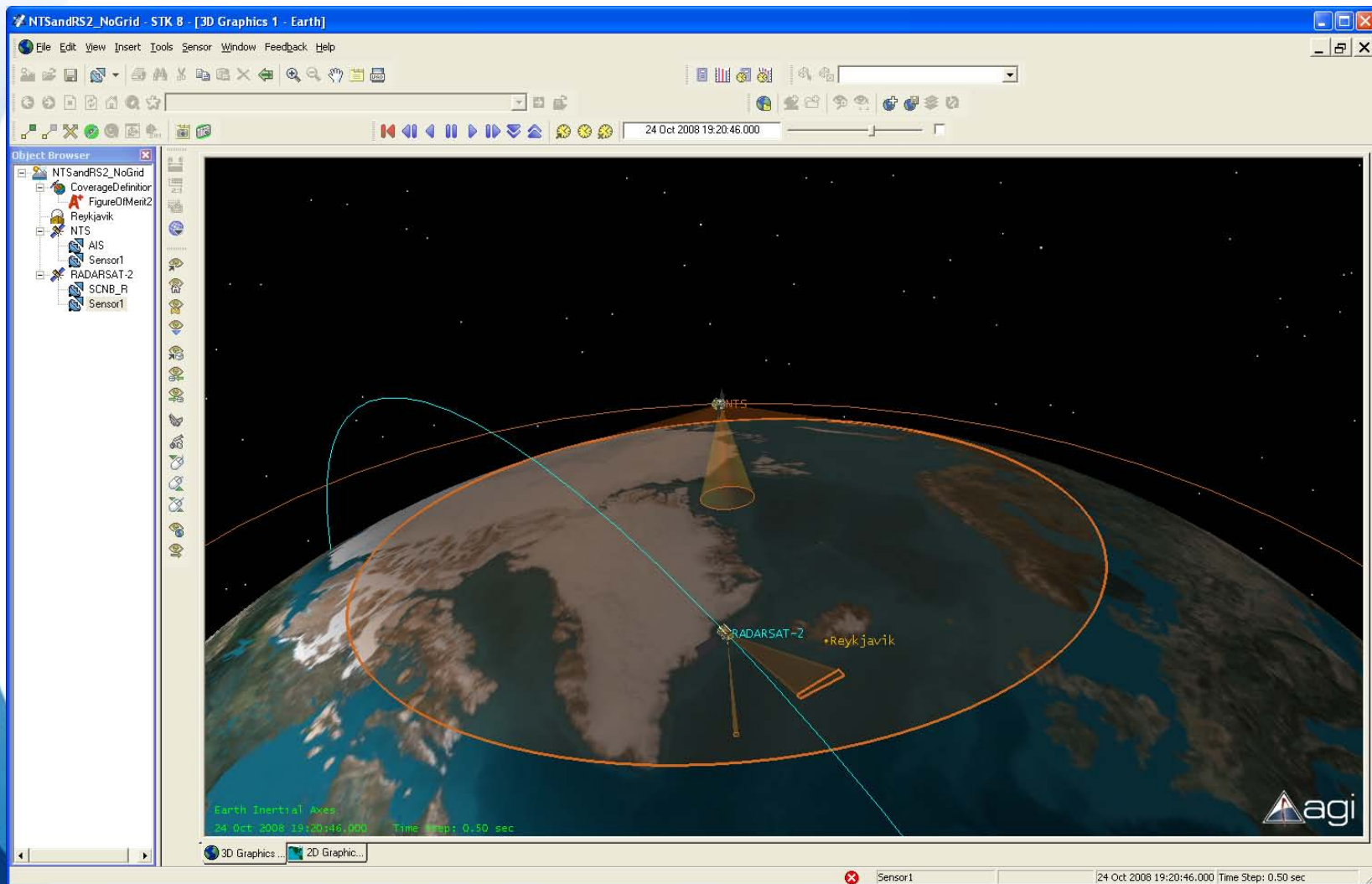
Maritime Safety and Security Information System (MSSIS)



Building global awareness of vessel traffic based on an open network of local AIS collectors

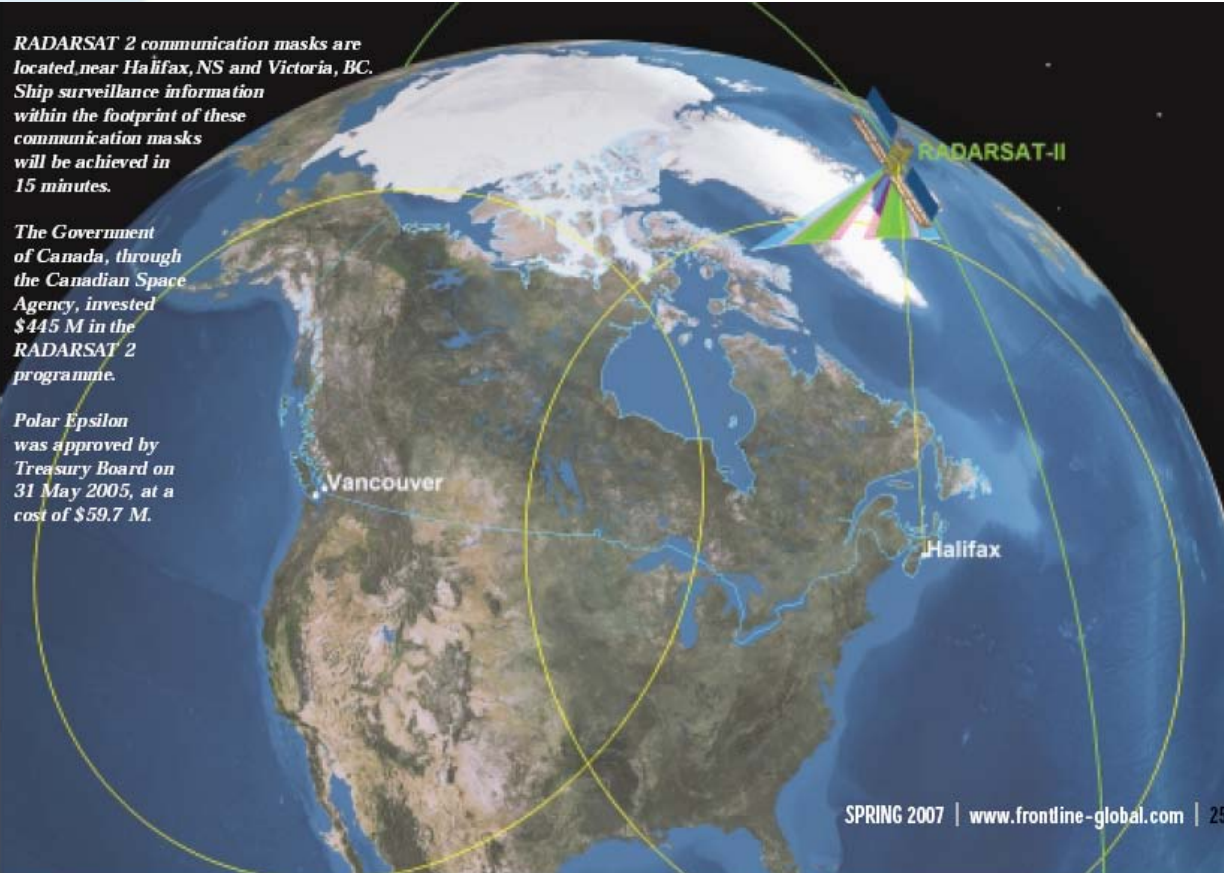


AIS Information Requires Corroboration: AIS and Radar

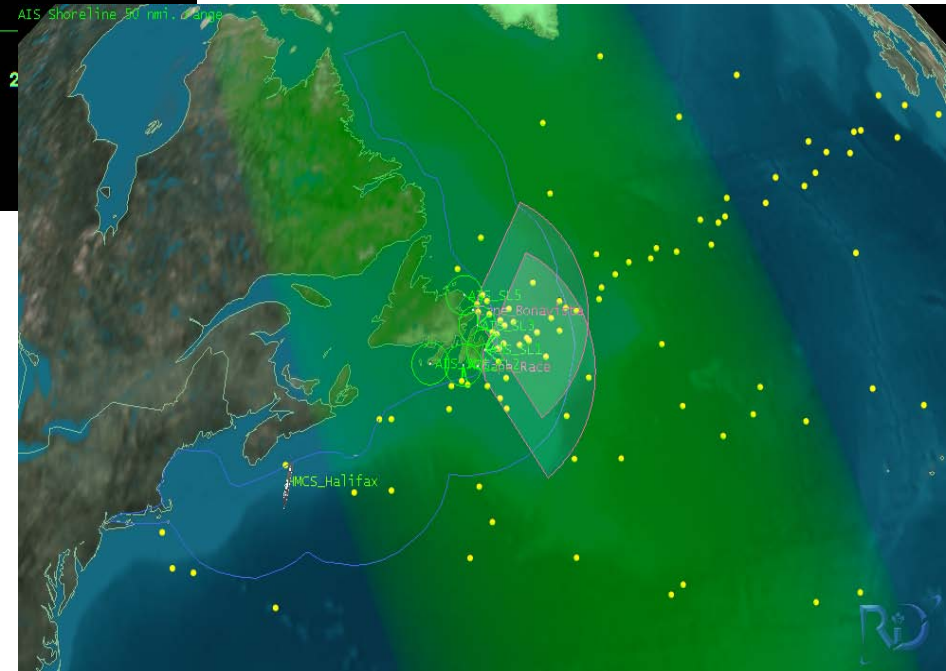




RADARSAT-2: Near Real-Time Ship Detection



- Near-real time ship detection (surveillance of Arctic, Pacific and Atlantic approaches);
- DND RADARSAT-2 ground stations on the east and west coasts;
- OceanSuite ship detection software.





Exploitation of Space-Based AIS: Objectives

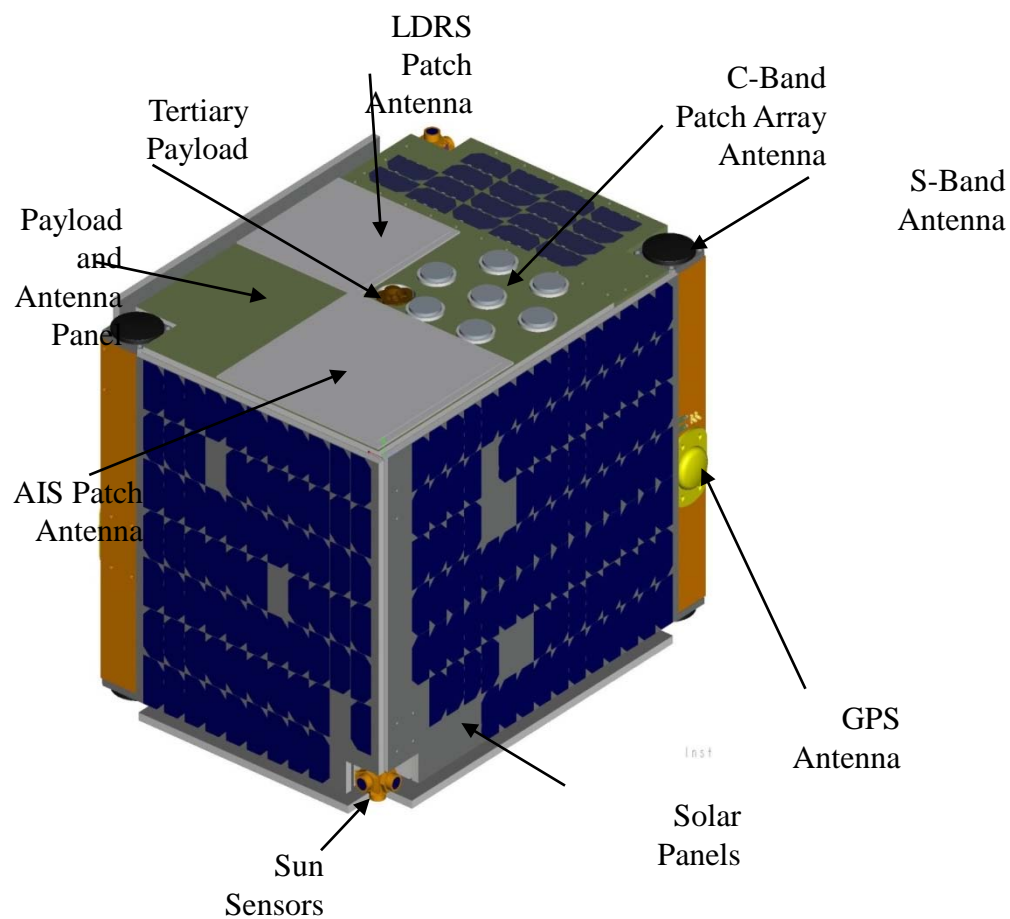
- To develop and demonstrate the utility of space-based AIS collection through the extension of AIS coverage to the middle/outer maritime zones
- To support risk reduction activities for the CSA RADARSAT Constellation mission
- To delivery of an effective military capability through a responsive and cost effective microsatellite program.
- To further develop the DND/CSA collaborative relationship to establish foundations for effective space development programs in the future.



Space Segment

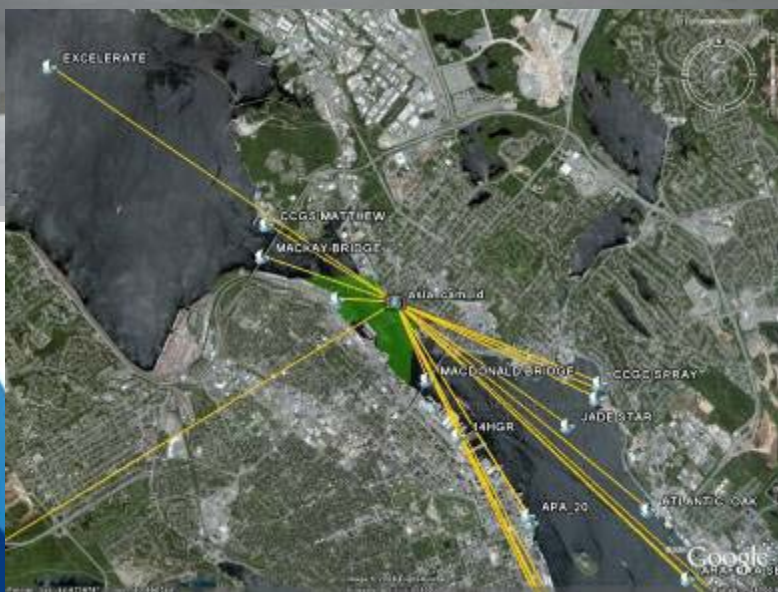


- Multi-Mission Platform approach (CSA)
 - Accommodate multiple payloads with multiple requirements
- Three payloads
 - DND AIS package
 - 2 CSA payloads
- Orbit Parameters
 - 680-800 km altitude
 - Near-polar
- Launch: Mar 2011





Automated Ship Imagery Acquisition: Integration of AIS and Imagery





Persistent, Active Surveillance of the EEZ (PASE) TDP: Objectives

- Conduct comparative analysis of sensor technologies that can potentially meet requirements for persistent, active surveillance of the Exclusive Economic Zone (EEZ) within a 10 year timeframe
- Pending the outcome of the options analysis, demonstrate next-generation High Frequency Surface Wave Radar (HFSWR) technology that complies with Industry Canada (IC) guidelines for interference mitigation.

L-88A microwave radar on aerostat



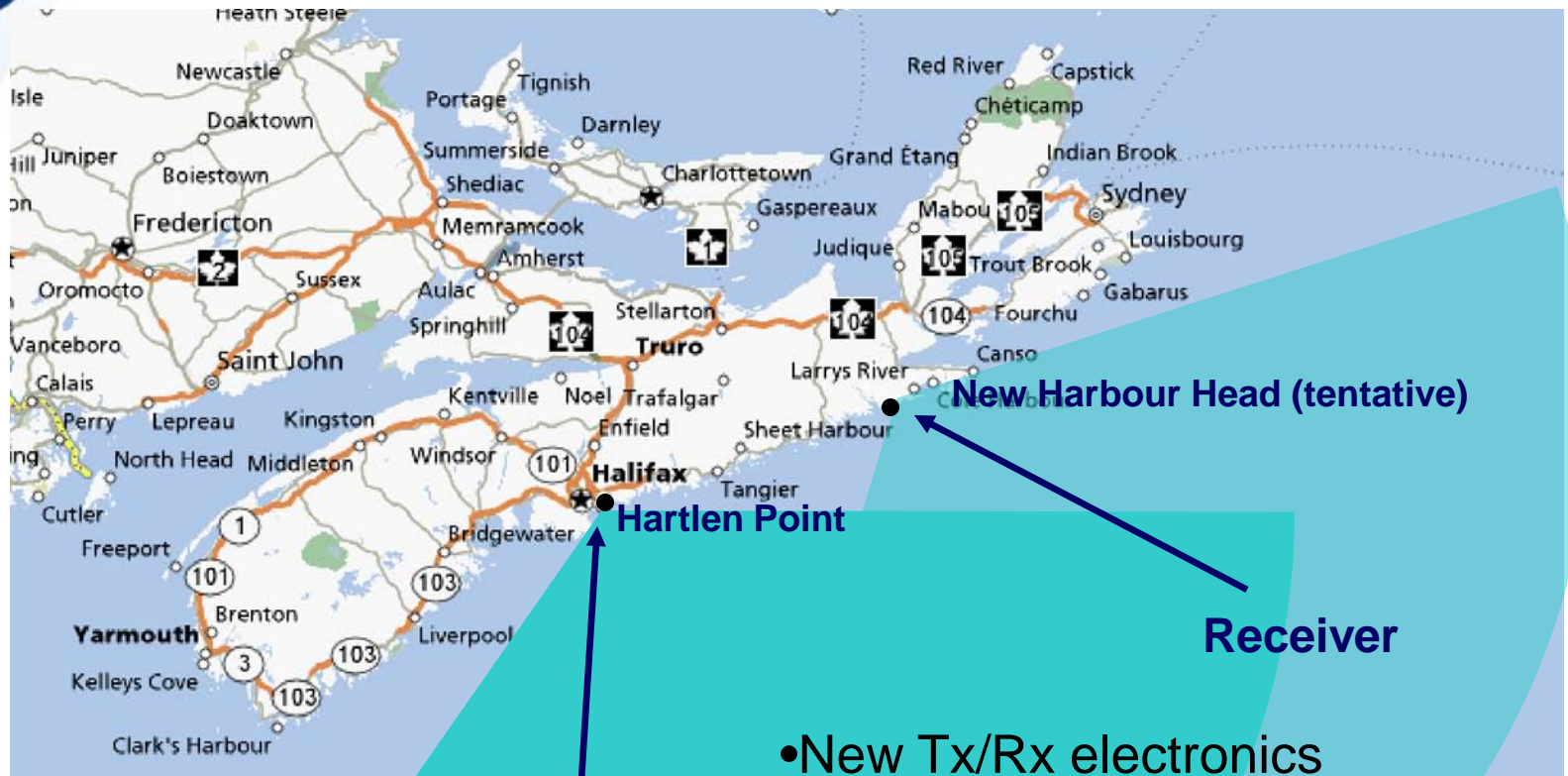
HFSWR transmit array in Newfoundland



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Persistent Active Surveillance of the EEZ (PASE): Bistatic HFSWR Trial Sites



Transmitter

Receiver

- New Tx/Rx electronics
- Pulsed waveform
- Trial to demo real-time tracking
- Raw data collection
- Leverage off Multi-Sensor fusion In a Common-operating environment (MUSIC)



DRDC MDA Applied Research Projects

- Collaborative Knowledge Exploitation for MDA (Valcartier)
- Technologies for Trusted Maritime Situational Awareness (Atlantic)
- Multi-hypothesis Link Analysis for Anomaly Detection in the Maritime Domain (Valcartier)
- Maritime Security Planning and Analysis Tools (CORA)
- Maritime Domain Analysis Through Collaborative, Interactive Visualization (Valcartier)

Maritime Security Planning Tools and Analysis

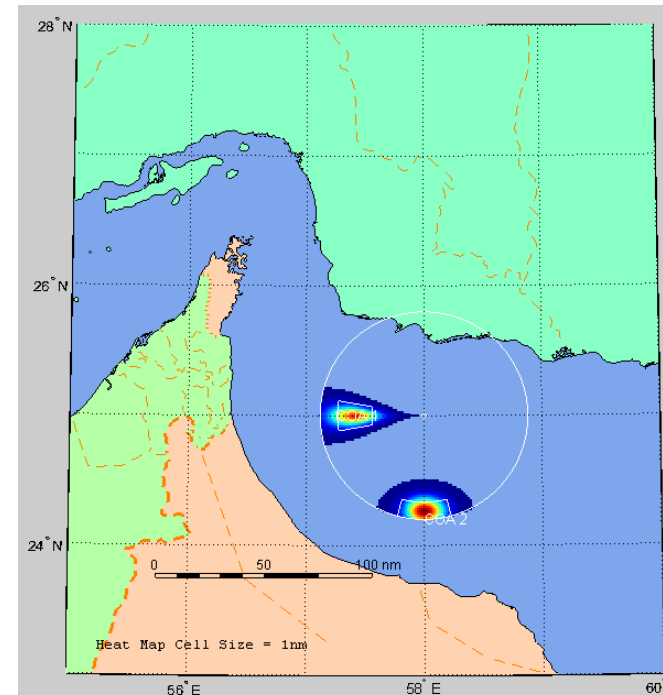
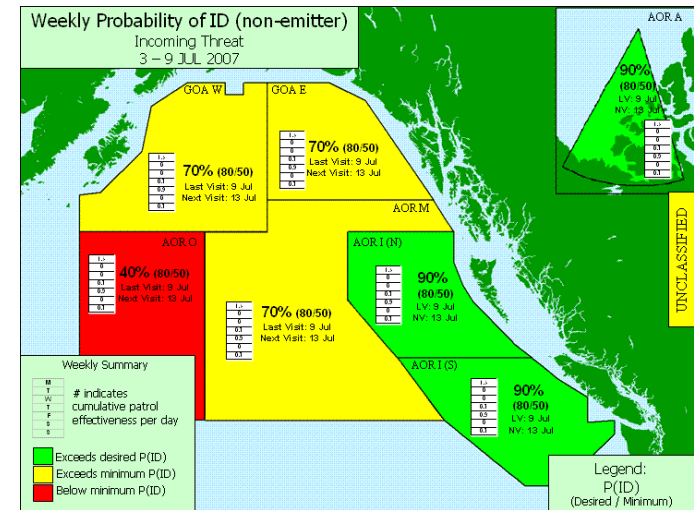
Objective:

Develop and facilitate implementation of tools and conduct analysis for:

- VOI reconnaissance planning
- MDA resource deployment
- RMP exploitation and analysis

Desired Outcomes:

- Improve effectiveness (e.g. operational concepts, situational awareness and resource deployment) in conducting maritime surveillance and interdiction operations at home and away
- Successful Demonstration of Spiral Development Process





Other OR Projects/Activities

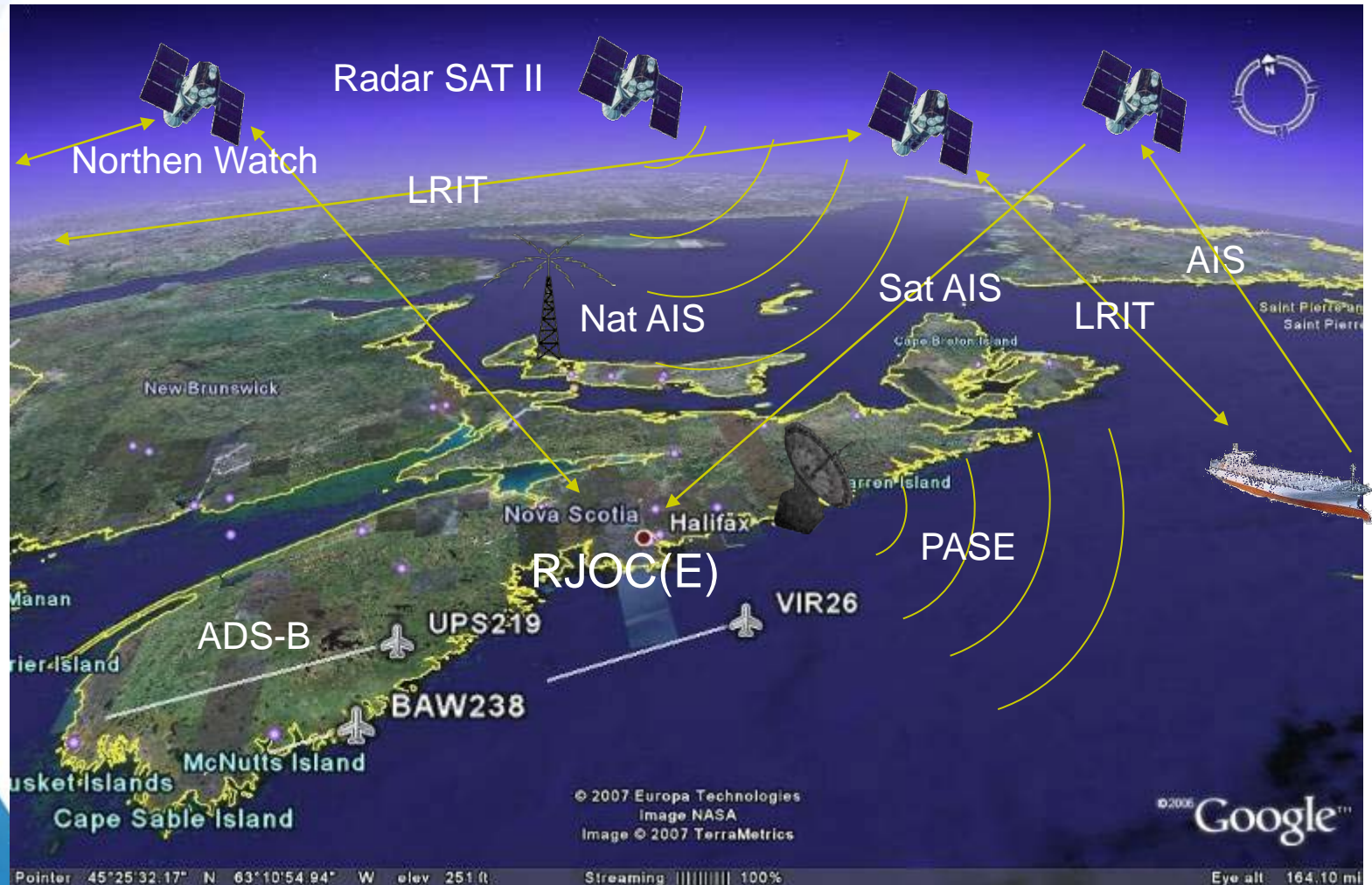
- UAV versus MPA tradeoff studies
- HFSR Effectiveness Studies
- Maritime Surface Traffic Density Simulation Model
- Requirements Analysis of Space Based Systems
- Ontology-Based Approach to ISR Systems
- Joint ISR CONOPS



OR&A MDA Challenges



New Maritime Information/Data Sources: The Coming Flood





Challenges in MDA Information and Knowledge Management

- Exponentially growing volumes of data and information- especially from non-military sources in littoral areas.
 - Scalable algorithms to handle large regional and global data and information sets
- Which is most trusted? How do we improve trust in information?
 - Consistency, corroboration, validation etc.
- Threat and hazard discovery while balancing need-to-know, with need-to-share and with right-to-know and right-to-share



MDA Balance of Investment Studies

- Investments to improve quality of RMP/MDA:
 - Sensors and Processing
 - Coordinated Tasking of Collection Assets
 - Processing and Exploitation of Information
 - Posting and Dissemination of Products
 - Automation of process for VOI identification
 - Fusion of Information
 - Sharing of information across security domains
 - Data mining
 - Archiving of information
 - Expert Systems and Process Automation
- Investment will depend on CONOPS and Aim of MDA
- Models needed to look at emergent behaviours with technology investments

Questions?



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